provide context and enhance system design. These findings inform future e-learning system development, emphasizing the need for adaptive, data-driven approaches to deliver personalized, engaging, and effective learning experiences.

VI. Conclusion and Future Work

This study developed and evaluated a recommendation system for e-learning platforms that integrates diversity and novelty to improve user satisfaction. By using the K-Means clustering algorithm, the system delivered personalized and diverse course recommendations. Evaluation results showed an Intra-List Diversity (ILD) of 0.6160443283 and Mean Self-Information (MSI) of 0.6281356136, confirming the system's ability to provide varied and novel suggestions. User satisfaction surveys revealed positive feedback, with significant agreement on the system's effectiveness in meeting user needs and enhancing the learning experience, particularly in its ability to suggest diverse and novel courses. These findings highlight the importance of balancing accuracy with diversity and novelty to enhance user satisfaction and usability.

The implications of these results emphasize the potential for recommendation systems to support personalized learning pathways and reduce information overload on e-learning platforms. Future work should explore integrating additional user data, such as learning goals, skill levels, and course difficulty, to further enhance personalization. Advanced clustering methods, such as DBSCAN or hierarchical clustering, and adaptive models like deep learning or reinforcement learning, could better address dynamic user preferences. Evaluating long-term outcomes, such as user engagement, course completion rates, and learning achievements, would provide a deeper understanding of the system's impact. Testing the system on larger, more diverse datasets would also improve scalability and applicability in real-world scenarios. These advancements could significantly enhance the role of recommendation systems in creating meaningful and engaging digital learning experiences.

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